

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A heat treatment apparatus comprising:
 - a plurality of induction heating devices which heat a steel product;
 - a correctional device for correcting the steel product;
 - a computing device which computes supply predetermined electric power which is supplied to the induction heating devices, on the basis of a size of the steel product, a conveying speed of the steel product, heating target temperatures of the steel product, and a predetermined temperature of the steel product at the previous stage of the induction heating devices; and
 - a power supply unit which supplies the supply predetermined electric power computed by the computing device to the induction heating devices,
- wherein the computing device computes supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the heating is completed falls within a predetermined range, or so that the steel product has a surface equal to or higher than a third target temperature while being heated and has a temperature equal to or lower than a fourth target temperature at the predetermined ~~position~~position in the thickness direction of the steel product when the heating is completed.

2. (Original) The heat treatment apparatus according to claim 1, wherein the induction heating devices are disposed on a rolling line of the steel product, and heat the steel product which was swiftly cooled by an accelerated cooling device after rolling.

3. (Original) The heat treatment apparatus according to claim 1, wherein the conveying speed of the steel product is a conveying speed determined in advance on the basis of the size of the steel product.

4. (Original) The heat treatment apparatus according to claim 1, wherein the computing device includes:

temperature estimating means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

fitting judging means for judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions;

judging processing means for correcting the supply predetermined electric power when they are not fit for the temperature conditions, and for repeatedly executing the temperature estimating means and the fitting judging means; and

electric power determining means for determining the supply predetermined electric power used for the computing as electric power which is supplied to the induction heating devices when they are fit for the temperature conditions.

5. (Original) The heat treatment apparatus according to claim 1, wherein the computing device includes:

temperature estimating means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

fitting judging means for judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions;

judging processing means for correcting the supply predetermined electric power when they are not fit for the temperature conditions, and for repeatedly executing the temperature estimating means and the fitting judging means;

electric energy judging means for judging whether or not a total value of electric energy of the respective induction heating devices used for the heating of the steel product is fit for the electric power condition which is less than or equal to a predetermined value, on the basis of the supply predetermined electric power used for the computing when they are fit for the temperature conditions; and

electric power determining means for determining the supply predetermined electric power used for the computing as electric power which is supplied to the induction heating devices when they are fit for the temperature conditions.

6. (Original) The heat treatment apparatus according to claim 1, wherein the computing device includes:

temperature estimating means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the

data including the conveying speed of the steel product and the supply predetermined electric power;

fitting judging means for judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions; and

electric power determining means for determining supply predetermined electric power in which a total value of the electric energy of the respective induction heating devices used for the heating of the steel product becomes a minimum, among the supply predetermined electric powers which are fit for the temperature conditions, as electric power which is supplied to the induction heating devices.

7. (Original) The heat treatment apparatus according to claim 1, wherein the computing device further includes

temperature distribution estimating means for estimating a temperature distribution in the thickness direction of the steel product after being heated by the induction heating devices.

8. (Original) The heat treatment apparatus according to claim 7, wherein the temperature distribution estimating means includes:

generated heat amount calculating means for obtaining an induced current distribution in the thickness direction of the steel product present in the induction heating devices, in accordance with a speed at which the steel product is being transported, and for calculating an amount of heat generated in the steel product.

radiated heat amount calculating means for calculating a radiated heat amount from the steel product to the atmosphere at the outside of the induction heating devices; and

temperature computing means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction due to a heat conduction to the inside of the steel product being computed with the generated heat amount and the radiated heat amount serving as the boundary conditions.

9. (Original) The heat treatment apparatus according to claim 7, wherein the temperature distribution estimating means includes cooling temperature estimating means for estimating a temperature falling amount in the thickness direction of the steel product by a correctional device.

10. (Original) The heat treatment apparatus according to claim 1, wherein the computing device further includes

heating history managing means for imaginarily dividing into a plurality of sections in the longitudinal direction of the steel product, and for managing the history, in unit of the section, of the heating electric power used for the heating of the steel product and the temperature detected value of the steel product.

11. (Original) The heat treatment apparatus according to claim 1, wherein the computing device includes:

temperature estimating means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

fitting judging means for judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions; and

electric power determining means for determining supply predetermined electric power in which the conveying speed of the steel product becomes a maximum, among the supply predetermined electric powers which are fit for the temperature conditions, as electric power which is supplied to the induction heating devices.

12. (Original) The heat treatment apparatus according to claim 1, wherein the computing device includes:

temperature estimating means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

fitting judging means for judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions;

judging processing means for correcting the supply predetermined electric power when they are not fit for the temperature conditions, and for repeatedly executing the temperature estimating means and the fitting judging means;

electric power judging means for judging whether or not a total value of electric energy of the respective induction heating devices used for the heating of the steel product is fit for the electric power condition which is less than or equal to a predetermined value, on the basis of the supply predetermined electric power used for the computing when they are fit for the temperature conditions; and

conveying speed computing means for repeatedly executing the temperature estimating means, the fitting judging means, the judging processing means, and the electric power judging

means, until it is not fit for the temperature conditions, by using a new conveying speed in which the conveying speed is increased when they are fit for the temperature conditions, and for acquiring the conveying speed which is fit for the temperature condition and the electric power condition and which was used for the final computing, as the new conveying speed.

13. (Currently Amended) A heat treatment apparatus comprising:

a plurality of induction heating devices which are disposed on a rolling line of a steel product, and which are arranged at the rear stage of an accelerated cooling device swiftly cooling the rolled steel product;

a correctional device which corrects the steel product;

at least one temperature detector which is disposed on the rolling line and which detects a temperature of the steel product;

a computing device which computes supply predetermined electric power which is supplied to the induction heating devices, on the basis of a size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, and an actually measured temperature of the steel product measured by the temperature detector at the previous stage of the induction heating devices; and

a power supply unit which supplies the supply predetermined electric power computed by the computing device to the induction heating devices,

wherein the computing device computes supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the

heating is completed falls within a predetermined range, or so that the steel product has a surface equal to or higher than a third target temperature while being heated and has a temperature equal to or lower than a fourth target temperature at the predetermined ~~position~~position in the thickness direction of the steel product when the heating is completed.

14. (Original) The heat treatment apparatus according to claim 13, wherein the computing device includes:

estimating means for estimating a steel product temperature after being heated on the basis of the conveying speed and the steel product temperature which was measured by the temperature detector;

repeating means for changing the conveying speed when the estimated steel product temperature is not within a predetermined temperature range, and for repeatedly executing the estimating means; and

electric power computing means for computing supply predetermined electric power which is supplied to the induction heating devices in order to heat the steel product to a target temperature on the basis of the conveying speed when the estimated steel product temperature is within the predetermined temperature range.

15. (Original) The heat treatment apparatus according to claim 13, wherein the computing device includes:

temperature estimating means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

fitting judging means for judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions;

judging processing means for correcting the supply predetermined electric power when they are not fit for the temperature conditions, and for repeatedly executing the temperature estimating means and the fitting judging means; and

electric power determining means for determining the supply predetermined electric power used for the computing as electric power which is supplied to the induction heating devices when they are fit for the temperature conditions.

16. (Original) The heat treatment apparatus according to claim 13, wherein the computing device includes:

temperature estimating means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

fitting judging means for judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions;

judging processing means for correcting the supply predetermined electric power when they are not fit for the temperature conditions, and for repeatedly executing the temperature estimating means and the fitting judging means;

electric energy judging means for judging whether or not a total value of electric energy of the respective induction heating devices used for the heating of the steel product is fit for the

electric power condition which is less than or equal to a predetermined value, on the basis of the supply predetermined electric power used for the computing when they are fit for the temperature conditions; and

electric power determining means for determining the supply predetermined electric power used for the computing as electric power which is supplied to the induction heating devices when they are fit for the temperature conditions.

17. (Original) The heat treatment apparatus according to claim 13, wherein the computing device includes:

temperature estimating means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

fitting judging means for judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions; and

electric power determining means for determining supply predetermined electric power in which a total value of the electric energy of the respective induction heating devices used for the heating of the steel product becomes a minimum, among the supply predetermined electric powers which are fit for the temperature conditions, as electric power which is supplied to the induction heating devices.

18. (Original) The heat treatment apparatus according to claim 13, wherein the computing device further includes

temperature distribution estimating means for estimating a temperature distribution in the thickness direction of the steel product after being heated by the induction heating devices.

19. (Original) The heat treatment apparatus according to claim 18, wherein the temperature distribution estimating means includes:

generated heat amount calculating means for obtaining an induced current distribution in the thickness direction of the steel product present in the induction heating devices, in accordance with a speed at which the steel product is being transported, and for calculating an amount of heat generated in the steel product.

radiated heat amount calculating means for calculating a radiated heat amount from the steel product to the atmosphere at the outside of the induction heating devices; and

temperature computing means for estimating a surface temperature of the steel product and an internal temperature in the thickness direction due to a heat conduction to the inside of the steel product being computed, with the generated heat amount and the radiated heat amount serving as the boundary conditions.

20. (Original) The heat treatment apparatus according to claim 18, wherein the temperature distribution estimating means includes cooling temperature estimating means for estimating a temperature falling amount in the thickness direction of the steel product by a correctional device.

21. (Original) The heat treatment apparatus according to claim 13, wherein the computing device further includes

heating history managing means for imaginarily dividing into a plurality of sections in the longitudinal direction of the steel product, and for managing the history, in unit of the

section, of the heating electric power used for the heating of the steel product and the temperature detected value of the steel product.

22. (Original) The heat treatment apparatus according to claim 21 comprising:

target temperature calculating means for calculating heating target temperatures for each induction heating device with respect to the head portion and the back end portion of the steel product on the basis of a temperature of the head portion and a temperature of the back end portion of the steel product which were detected by the temperature detector provided at the entrance side of the induction heating device at the first stage, and the conveying speed of the steel product;

electric power supplying means for calculating electric power supplied to each induction heating device on the basis of the heating target temperatures at the head portion and the back end portion of the steel product, and for controlling the electric power in accordance with the movements of the head portion and the back end portion of the steel product and supplying it to the power supply unit;

intermediate portion target temperature calculating means, at the intermediate portion sandwiched by the head portion and the back end portion of the steel product, on the basis of an actually measured temperature at the head portion of the steel product, an actually measured temperature at the back end portion, and an actually measured temperature at the intermediate portion, for correcting the heating target temperatures for each induction heating device at the head portion and the back end portion of the steel product, and for calculating the heating target temperatures for each induction heating device at the intermediate portion; and

intermediate electric power controlling means for calculating intermediate electric power supplied to each induction heating device on the basis of the heating target temperature of each

induction heating device at the intermediate portion, and for controlling the intermediate electric power in accordance with the movement of the intermediate portion of the steel product and supplying it to the power supply unit.

23. (Original) The heat treatment apparatus according to claim 13 which includes the temperature detectors before and behind at least one of the induction heating devices, wherein the computing device includes:

heating efficiency estimating means for estimating a heating efficiency of the induction heating devices on the basis of the electric power supplied to the induction heating devices and the rose temperature of the steel product which was measured by the temperature detector; and

correction computing means for correction-computing the electric power determined with respect to the steel product for which a heat treatment is planned next time by using the heating efficiency.

24. (Original) The heat treatment apparatus according to claim 13, wherein the computing device includes:

temperature falling amount correcting means for correcting the radiated heat amount to the atmosphere from the steel product on the rolling line by an actual measured temperature; and

cooling correction electric power computing means for computing supply predetermined electric power for heating the steel product to a target temperature on the basis of the temperature falling amount estimated by the corrected radiated heat amount, with respect to the steel product for which a heat treatment is planned next time.

25. (Original) The heat treatment apparatus according to claim 13, wherein the computing device includes:

temperature falling amount correcting means for correcting the temperature falling amount by the correctional device of the steel product on the rolling line, by the actual measured temperature measured by the temperature detectors disposed before and behind the correctional device; and

cooling correction electric power computing means for computing supply predetermined electric power for heating the steel product to a target temperature on the basis of the corrected temperature falling amount at the correctional device, with respect to the steel product for which a heat treatment is planned next time.

26. (Original) The heat treatment apparatus according to claim 13 which includes at least one of the temperature detectors between the induction heating devices, further comprising:

feedback control means for controlling electric power which is supplied to the induction heating device at the previous stage on the basis of a difference between the steel product temperature measured by the temperature detector and the target temperature at the position which was provided in advance; and

feedforward control means for controlling electric power which is supplied to the induction heating device at the rear stage on the basis of a difference between the steel product temperature measured by the temperature detector and the target temperature at the position which was provided in advance.

27. (Original) The heat treatment apparatus according to claim 26, wherein the feedback control means controls electric power supplied to the induction heating device at the previous stage on the basis of a difference between the steel product temperature measured by the temperature detector and the target temperature at the position which is provided in advance, in

units of the plurality of sections which were imaginarily divided in the longitudinal direction of the steel product.

28. (Original) The heat treatment apparatus according to claim 26, wherein the feedforward control means controls heating electric power supplied to the induction heating device at the rear stage on the basis of a difference between the steel product temperature measured by the temperature detector and the target temperature at the position which is provided in advance, in units of the plurality of sections which were imaginarily divided in the longitudinal direction of the steel product.

29. (Currently Amended) A heat treatment apparatus comprising:
a plurality of induction heating devices which are disposed on a rolling line of a steel product, and which are arranged at the rear stage of an accelerated cooling device swiftly cooling the rolled steel product;

a correctional device which corrects correcting the steel product;

at least one temperature detector which is disposed on the rolling line and which detects a temperature of the steel product;

a first computing device which computes first supply predetermined electric power which is supplied to the induction heating devices, on the basis of a size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, and a predetermined temperature of the steel product at the previous stage of the induction heating devices;

a second computing device which computes second supply predetermined electric power which is supplied to the induction heating devices, on the basis of the size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, and an

actually measured temperature of the steel product measured by the temperature detector at the previous stage of the induction heating devices;

an electric power selecting device which selects the first supply predetermined electric power as supply predetermined electric power when a difference between the predetermined temperature of the steel product and the actual measured temperature of the steel product is within a predetermined range, and which selects the second supply predetermined electric power as supply predetermined electric power when a difference between the predetermined temperature of the steel product and the actual measured temperature of the steel product is not within a predetermined range; and

a power supply unit which supplies the supply predetermined electric power selected by the electric power selecting device to the induction heating devices,

wherein the first and the second computing devices compute supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the heating is completed falls within a predetermined range, or so that the steel product has a surface equal to or higher than a third target temperature while being heated and has a temperature equal to or lower than a fourth target temperature at the predetermined position in the thickness direction of the steel product when the heating is completed.

30. (Currently Amended) A heat treatment method of a heat treatment apparatus which includes a plurality of induction heating devices which heat a steel product, a correctional device for correcting the steel product, a computing device which computes supply predetermined

electric power which is supplied to the induction heating device, and a power supply unit which supplies the supply predetermined electric power computed by the computing devices to the induction heating device, comprising:

on the basis of a size of the steel product, a conveying speed of the steel product, heating target temperatures of the steel product, a predetermined temperature of the steel product at the previous stage of the induction heating device,

a step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the heating is completed falls within a predetermined range; or

a step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface equal to or higher than a third target temperature while being heated and has a temperature equal to or lower than a fourth target temperature at the predetermined ~~position~~ position in the thickness direction of the steel product when the heating is completed.

31. (Original) The heat treatment method according to claim 30, wherein the induction heating devices are disposed on a rolling line of the steel product, and heat the steel product which was swiftly cooled by an accelerated cooling device after rolling.

32. (Original) The heat treatment method according to claim 30, wherein the conveying speed of the steel product is a conveying speed determined in advance on the basis of the size of the steel product.

33. (Original) The heat treatment method according to claim 30 further comprising:

a temperature estimating step of estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

a fitting judging step of judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions;

a judging processing step of correcting the supply predetermined electric power when they are not fit for the temperature conditions, and of repeatedly executing the temperature estimating means and the fitting judging means; and

an electric power determining step of determining the supply predetermined electric power used for the computing as electric power which is supplied to the induction heating devices when they are fit for the temperature conditions.

34. (Currently Amended) A heat treatment method of a heat treatment apparatus which includes a plurality of induction heating devices which are disposed on a rolling line of a steel product, and which are arranged at the rear stage of an accelerated cooling device swiftly cooling the rolled steel product, a correctional device which corrects the steel product, at least one temperature detector which is disposed on the rolling line and which detects a temperature of the steel product, a computing device which computes supply predetermined electric power which is supplied to the induction heating device, and a power supply unit which supplies the supply predetermined electric power computed by the computing device to the induction heating devices, comprising:

on the basis of a size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, and an actually measured temperature of the steel product measured by the temperature detector at the previous stage of the induction heating devices,

a step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the heating is completed falls within a predetermined range; or

a step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface equal to or higher than a third target temperature while being heated and has a temperature equal to or lower than a fourth target temperature at the predetermined ~~position~~position in the thickness direction of the steel product when the heating is completed.

35. (Original) The heat treatment method according to claim 34 further comprising:

an estimating step of estimating a steel product temperature after being heated on the basis of the conveying speed and the steel product temperature which was measured by the temperature detector;

a repeating step of changing the conveying speed, and of repeatedly executing the estimating means when the estimated steel product temperature is not within a predetermined temperature range; and

an electric power computing step of computing supply predetermined electric power which is supplied to the induction heating devices in order to heat the steel product to a target temperature on the basis of the conveying speed when the estimated steel product temperature is within the predetermined temperature range.

36. (Currently Amended) A heat treatment method of a heat treatment apparatus which includes a plurality of induction heating devices which are disposed on a rolling line of a steel product, and which are arranged at the rear stage of an accelerated cooling device swiftly cooling the rolled steel product, a correctional device which corrects the steel product, at least one temperature detector which is disposed on the rolling line and which detects a temperature of the steel product, a computing device which computes supply predetermined electric power which is supplied to the induction heating devices, and a power supply unit which supplies the computed supply predetermined electric power to the induction heating devices, comprising:

a supply predetermined electric power computing step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the heating is completed falls within a predetermined range; or

a supply predetermined electric power computing step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface equal to or higher than a third target temperature while being heated and has a temperature equal to or lower than a fourth target

temperature at the predetermined ~~position~~position in the thickness direction of the steel product when the heating is completed;

a step of executing the supply predetermined electric power computing step on the basis of a size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, a predetermined temperature of the steel product at the previous stage of the induction heating devices when a difference between the predetermined temperature of the steel product and the actual measured temperature of the steel product is within a predetermined range; and

a step of executing the supply predetermined electric power computing step on the basis of the size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, and an actually measured temperature of the steel product measured by the temperature detector at the previous stage of the induction heating devices when a difference between the predetermined temperature of the steel product and the actual measured temperature of the steel product is not within a predetermined range.

37. (Currently Amended) A recording medium on which a heat treatment program is recorded, of a heat treatment apparatus which includes a plurality of induction heating devices which heat a steel product, a correctional device which corrects the steel product, a computing device which computes supply predetermined electric power which is supplied to the induction heating device, and a power supply unit which supplies the supply predetermined electric power computed by the computing device to the induction heating devices,

the recording medium recording a program thereon for making a computer execute,

on the basis of a size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, a predetermined temperature of the steel product at the previous stage of the induction heating devices,

a step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the heating is completed falls within a predetermined range; or

a step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface equal to or higher than a third target temperature while being heated and has a temperature equal to or lower than a fourth target temperature at the predetermined ~~position~~position in the thickness direction of the steel product when the heating is completed.

38. (Original) The recording medium according to claim 37, wherein the induction heating devices are disposed on a rolling line of the steel product, and heat the steel product which was swiftly cooled by an accelerated cooling device after the rolling.

39. (Original) The recording medium according to claim 37, wherein the conveying speed of the steel product is a conveying speed determined in advance on the basis of the size of the steel product.

40. (Original) The recording medium according to claim 37 recording a program thereon for making a computer further execute,

a temperature estimating step of estimating a surface temperature of the steel product and an internal temperature in the thickness direction after induction heating on the basis of the data including the conveying speed of the steel product and the supply predetermined electric power;

a fitting judging step of judging whether or not the surface temperature of the steel product and the internal temperature in the thickness direction are fit for predetermined temperature conditions;

a judging processing step of correcting the supply predetermined electric power when they are not fit for the temperature conditions, and of repeatedly executing the temperature estimating means and the fitting judging means; and

an electric power determining step of determining the supply predetermined electric power used for the computing as electric power which is supplied to the induction heating devices when they are fit for the temperature conditions.

41. (Currently Amended) A recording medium on which a heat treatment program is recorded, of a heat treatment apparatus which includes a plurality of induction heating devices which are disposed on a rolling line of a steel product, and which are arranged at the rear stage of an accelerated cooling device swiftly cooling the rolled steel product, a correctional device which corrects the steel product, at least one temperature detector which is disposed on the rolling line and which detects a temperature of the steel product, a computing device which computes supply predetermined electric power which is supplied to the induction heating device, and a power supply unit which supplies the supply predetermined electric power computed by the computing device to the induction heating devices,

the recording medium recording a program thereon for making a computer execute,

on the basis of a size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, and an actually measured temperature of the steel product measured by the temperature detector at the previous stage of the induction heating devices,

a step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the heating is completed falls within a predetermined range; or

a step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface equal to or higher than a third target temperature while being heated and has a temperature equal to or lower than a fourth target temperature at the predetermined ~~position~~position in the thickness direction of the steel product when the heating is completed.

42. (Original) The recording medium according to claim 41 further recording a program thereon for making a computer execute:

an estimating step of estimating a steel product temperature after being heated on the basis of the conveying speed and the steel product temperature which was measured by the temperature detector;

a repeating step of changing the conveying speed when the estimated steel product temperature is not within a predetermined temperature range, and for repeatedly executing the estimating means; and

an electric power computing step of computing supply predetermined electric power which is supplied to the induction heating devices in order to heat the steel product to a target temperature on the basis of the conveying speed when the estimated steel product temperature is within the predetermined temperature range.

43. (Currently Amended) A recording medium on which a heat treatment program is recorded, of a heat treatment apparatus which includes a plurality of induction heating devices which are disposed on a rolling line of a steel product, and which are arranged at the rear stage of an accelerated cooling device swiftly cooling the rolled steel product, a correctional device which corrects the steel product, at least one temperature detector which is disposed on the rolling line and which detects a temperature of the steel product, a computing device which computes supply predetermined electric power which is supplied to the induction heating devices, and a power supply unit which supplies the computed supply predetermined electric power to the induction heating devices,

the recording medium recording a program thereon for making a computer execute:

a supply predetermined electric power computing step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface temperature equal to or lower than a first target temperature while being heated, and a difference between a second target temperature and a temperature which the steel product has at a predetermined position in the thickness direction of the steel product when the heating is completed falls within a predetermined range; or

a supply predetermined electric power computing step of computing supply predetermined electric power to be supplied to the induction heating devices in order to heat the steel product so that the steel product has a surface equal to or higher than a third target

temperature while being heated and has a temperature equal to or lower than a fourth target temperature at the predetermined ~~position~~position in the thickness direction of the steel product when the heating is completed;

a step of executing the supply predetermined electric power computing step on the basis of a size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, a predetermined temperature of the steel product at the previous stage of the induction heating devices when a difference between the predetermined temperature of the steel product and the actual measured temperature of the steel product is within a predetermined range; and

a step of executing the supply predetermined electric power computing step on the basis of the size of the steel product, a conveying speed of the steel product, a heating target temperature of the steel product, and an actually measured temperature of the steel product measured by the temperature detector at the previous stage of the induction heating devices when a difference between the predetermined temperature of the steel product and the actual measured temperature of the steel product is not within a predetermined range.

44.-50. Canceled.

51. (New) A method for manufacturing a steel product comprising the steps of:

heating a steel slab to around 1200°C in a heating furnace;

hot rolling the steel slab to form a steel product having a temperature of 800 to 1000°C;

water cooling or air cooling the steel product from the hot rolling step; and

heating the cooled steel product by the heat treatment method according to claim 30.

52. (New) A method for manufacturing a steel product comprising the steps of:

heating a steel slab to around 1200°C in a heating furnace;

hot rolling the steel slab to form a steel product having a temperature of 800 to 1000°C;

water cooling or air cooling the steel product from the hot rolling step; and

heating the cooled steel product by the heat treatment method according to claim 34.

53. (New) A method for manufacturing a steel product comprising the steps of:

heating a steel slab to around 1200°C in a heating furnace;

hot rolling the steel slab to form a steel product having a temperature of 800 to 1000°C;

water cooling or air cooling the steel product from the hot rolling step; and

heating the cooled steel product by the heat treatment method according to claim 36.